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ABSTRACT

This study explored the use of multiple-choice item formats and performance formats for assessment of learning science at the second grade level. It was completed during a 2-week unit entitled "Living Systems" that addressed Virginia Standards of Learning for second grade science. A 7-day unit was designed and both multiple-choice and performance tests were written to assess knowledge and achievement of objectives on days 1, 3, 5, and 7. Subjects were 16 students from a second grade in a rural school, although the number of students tested varied due to school absences. Both test formats included higher order thinking questions. The range of scores for both formats was similar. However, several disadvantages to performance tests were discovered, mostly related to time and efficiency of testing. Further study is suggested to overcome these disadvantages. Until these are overcome, the multiple-choice format should be the preferred method of testing. Appendixes contain the lesson plans, the unit tests, and a table and four figures of research data. (Contains 28 references.) (Author/SLD)

Assessment in Science: An examination of Multiple-Choice and Performance Science Assessments For a Second Grade Classroom

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Running head: Assessment in Science

Abstract

This study explored the use of multiple-choice item formats and performance formats for assessment of learning science at the second grade level. It was completed during a two week unit entitled Living Systems that addressed Virginia Standards of Learning for second grade science. A seven day unit was designed and both multiple-choice and performance tests were written to assess knowledge and achievement of objectives on days one, three, five, and seven. Both test formats included higher-order thinking questions. The unit was taught and tests were administered. The range of test scores for both formats was similar. Several disadvantages to performance tests were discovered. Opportunity for further study to attempt to overcome these disadvantages is suggested. Until these negative factors can be dealt with, the multiple-choice format should be the preferred method of testing.

Assessment in Science: An examination of the Multiple Choice and Performance Science Assessments For a Second Grade Classroom

Introduction

Assessment in education has become a primary focal point in education. In Virginia this has been made highly evident by the new Standards of Learning tests which will be given in the third and fifth grades, as well as at the junior and senior high levels. With the adoption and implementation of the new Standards of Learning there is a significant amount of political pressure placed on public educators to ensure that students are in fact learning the materials required by the state. For the first time in the history of education in Virginia, student knowledge and achievement in content areas, such as science, will begin to be assessed with tests designed by the state to match the rigorous standards it has set in these areas.

In recent years, many forms of assessments have been used to measure knowledge and achievement. Multiple choice, true-false, matching, short answer, and essay tests have either been replaced by or used in combination with newer styles of assessment such as the performance test. As classroom teachers and administrators in school divisions all across the state grapple with the best way to implement the objectives of the new Standards of Learning and to prepare students for the new state assessments they will take, they are also reevaluating the assessments teachers have been using in

the classroom. Everyone concerned wants to provide the best possible proof of how well students are achieving the objectives of the curriculum. Individual teachers must reflect on the types of assessments they are utilizing and ask themselves how much and what type of assessing should be done. We can not justify classroom assessments that are not efficient in the use of time or information gained. The multiple-choice assessment is often selected because of its lower costs in terms of time spent in administration and in scoring. It also has high reliability.

This study examines the multiple choice format compared to the performance test to determine which assessment is a better tool to measure knowledge and achievement of science in a second-grade classroom unit on the study of living systems. The unit was developed to incorporate portions of the Life Processes and Living Systems strands of the Science Standards of Learning. Both forms of assessment are used to measure knowledge and achievement. These are then evaluated in terms of the amount of time spent using the assessment and the information gained. The desired outcome of this study is a determination of the most efficient assessment of the new State Standards of Learning for science at the second grade level in terms of assessment time and a determination of the best measurement tool for achievement of classroom objectives.

Literature Review

Assessment Objectives

Assessment, in any form, must be preceded by clearly-defined instructional objectives. Well-stated objectives should be expressed in terms of measurable or observable performance. Instructional objectives provide both direction for instruction and guidelines for assessment (Gronlund, 1995). It is important to create a match between educational objectives, teaching strategies and activities. Beginning a unit of study without specific goals in mind is apt to cause both students and the teacher to flounder.

It would be unreasonable to assess cognitive behavior that has not been developed in the classroom to evaluate learning performance. "A fundamental assumption in writing any test item is that we know what we are testing" (Haladyna, 1997). This is not only for tests, but for any form of performance assessment. Demands for data to support student progress with additional testing must be tempered by reflection on instructional objectives. Educators must always consider what their objectives are and how they may best assess these goals.

There is no single best way to present information outlined in instructional objectives; both teaching styles and learning styles play an important role in determining how learning objectives should be

fulfilled and how performance should be evaluated. "Instructional planning tends to be more complex in elementary schools because students tend to be more differentiated and teachers must plan in many subject areas" (Airasian,1996). Individual teachers, however, become familiar with their teaching styles and the backgrounds of the students within their schools and strive to determine a method that works best for them.

Time is also a consideration when determining how objectives are to be met and measured. As schools take on an increasing responsibility for the care and education of children, economies of time are important in classrooms where increasing demands are made to teach more than reading, writing, and arithmetic. Teachers have a limited amount of time to plan and design appropriate achievement assessments.

Instructional objectives should include higher level cognitive behaviors. Guidelines such as Bloom's Taxonomy or Quellmalz Framework contain a range of learning outcomes to use both in planning and assessing instructional objectives (Grondlund 1998). Course content includes facts, concepts, principles, and procedures. Classroom teachers, in determining the process by which this content or information is gained, must consider what type of mental behavior will be developed and how it will be assessed (Haladyna, 1997). Content must be presented to students in a way

that will benefit them as they grow and become an integral part of society.

Both formative and summative assessments provide information which can be used to evaluate the success of the achievement of instructional objectives. Whichever method or combination of assessment methods is used should provide accurate information as it reflects the overall success of the process. Assessments can affect the grades, placement, and promotion, and may be used to communicate to parents how their child is achieving instructional objectives in a concrete manner (Airasian, 1996). With such a wide range of implications for affecting a student, it is imperative that assessments accurately reflect achievement.

Recent Strategies In Science Objectives and the Virginia State Standards of Learnings

Scientific thoughts in the 1970s began to reflect more concern for the process of science in its teaching. Observation, hypothesis testing, experimentation, classification, and communication were equally important as learning factual information (Kjoernsli 1992). These process skills are both cognitive and practical and, as such, are valuable in preparing students for dealing with real-life situations.

In an ever increasingly informational-technological society, educational institutions have had to add new basic skills to their

programs. "Communication, problem-solving, and scientific and technological literacy are needed by all students in order to successfully work and live in our changing World" (Smith, 1993). Research in cognitive thinking in science began to study the constructivist's view of learning, where students constructed their own knowledge by engaging in problem-solving experiences and integrating new information with prior knowledge. Current thinking about effective science is that the curriculum must focus on inquiry and relate facts and concepts to problem solving and reasoning skills (Smith,1993).

Society has also bemoaned the decline in student achievement reflected in lower standardized test scores. In response to criticisms about the educational system, the Virginia General Assembly adopted a rigorous set of Standards of Learning (SOL's) for grades kindergarten through twelfth. Beginning in 1998, new standardized examinations will be given in Virginia to measure students' progress in meeting the new SOL's. Virginia's science goals reflect current trends in science education. Students in the state will use experimental methods in scientific inquiry. They will apply concepts, skills, and processes to everyday experiences, and make informed decisions (Commonwealth of VA).

Multiple-choice Assessments

Classroom teachers must choose an assessment format that maintains fidelity to the instructional objectives and is feasible in terms of costs, time and effort. The multiple-choice format offers time efficiency in administration and scoring, and has the advantage of objectivity in scoring as well. Multiple-choice tests are versatile and can be written to assess higher cognitive thinking. Haladyna lists several reasons for using the Multiple-choice Format in his book, Writing Test Items To Evaluate Higher Order Thinking:

1. Better content domain sampling - because it permits broader sampling from desired student behaviors.
2. Higher reliability - - over time random error can be minimized.
3. Greater efficiency -- when writing items that can be used over again, as well as the administration and scoring time.
4. Objectivity -- identical scoring when a key or scoring template is used.
5. Measurability -- critical thinking and problem-solving abilities may be measured by multiple-choice tests.
6. Mechanical scoring -- machine scoring is possible (Haladyna, 1997).

Textbooks often provide multiple choice tests but primary school teachers, who generally do not have textbooks which cover all the

learning objectives they are required to teach, must either adapt these tests or create their own. Because of the many advantages to using the multiple-choice test, it is often the method selected. Studies show that 90 percent of elementary teachers construct their own tests and that science teachers, in general, have given multiple-choice test preference (Morris,1993).

Performance Assessments

Performance testing of mental skills and abilities is a relatively new method of assessment, yet it "dominates over half of the 50 states' testing programs already" (Haladyna, 1997). The reason for this spread in use can be attributed to the focus on higher level thinking as our society becomes increasingly complex. The American public is demanding more school accountability and this has often resulted in statistics based on test scores. The performance test is one attempt to shift focus from scores, which can be manipulated, back to the learning process. However, this method has a high cost in terms of time required to develop, administer, and score; and scoring may be bias or inconsistent. Estimates of performance tests cost relative to multiple-choice range from three to ten times as expensive (Haladyna, 1997) to 100 times as expensive (Brian 1995).

Performance tests require students to actively construct and communicate ideas, and to solve problems rather than recognize

them from a list of choices. Reforms in science education which emphasize the relationship between learning facts and concepts and developing process and problem solving skills in real world situations, have proposed changes in assessments to reflect a hands-on process. Typically science tests have not measured students' abilities to conduct science investigation (Smith, 1993). The performance test provides a format for measurement of this kind.

Purpose and Rationale

Classroom assessment plays an important role in the education of children. However, assessment must be efficient in terms of the time. Teachers must ask themselves if the knowledge gained from this assessment justifies the time it takes. The purpose of this study is to examine the use of the multiple-choice and performance assessments for use in the second grade science, specifically assessment of learning objectives for a unit on the study of living systems.

Do both multiple-choice and performance based tests give sufficient information to determine achievement of instructional objectives? Can test items be written at a second-grade level to adequately match the instructional objectives? Can multiple choice tests be effectively administered to second graders who are low

readers and may have difficulty with reading science terms? Will modifications be necessary and if so, will the modifications significantly reduce the efficiency or reliability of the test? Can a performance test cover the same type of information as a multiple-choice test? Will the information gained be valuable for making decisions? If not, which provides better information? Should the two assessments be used in combination to provide a complete picture of each student's achievement?

Using the procedures outlined below, this project examined the three basic questions that each second grade teacher must consider when considering using either multiple-choice or performance tests as an evaluation method for determining student achievement of instructional objectives. Can multiple choice and performance tests be written to adequately assess instructional objectives in science at a second-grade level? Is one method of assessment better at measuring knowledge and achievement? Is one method more efficient in terms of time spent in administration and scoring?

Procedure

Given the concepts, issues, and concerns discovered in the literature review, the following procedures were established to examine the use of multiple-choice and performance tests in the second grade classroom. The study was completed during a two

week period in one second grade class at Trevilians Elementary school in Louisa County, Virginia.

Development of Unit of Study and Accompanying Tests:

Lesson plans were developed for a science unit which incorporated portions of the Life Processes and Living Systems strands of the Science Standards of Learning for the state of Virginia. Seven separate 50-minute lessons were formulated to cover a two-week period of classroom instruction in the content area. (See appendix A.)

Four sets of performance and multiple-choice tests were constructed to assess objectives taught on days one, three, five, and seven of the unit. (See appendix B.) Both test formats were written to include higher order thinking questions. Questions on comparative tests were formulated to give as nearly equal weight to classroom objectives as possible. The multiple-choice tests, however, included a wider range of questioning. No attempt was made to weight one classroom objective over another on individual testing days. The narrow focus of content objectives taught in a fifty-minute period limited the number of possible questions. Multiple-choice tests items ranged from 11 to 20 and were equally weighted. Performance tests contained three parts which were weighted to coincide as near as possible with corresponding multiple-choice tests.

Test Subjects:

The second-grade class used in this study was comprised of 17 students who live in the rural county of Louisa. One student was not administered any of the tests because she received Title I services during the period of the day when testing was completed. The number of students tested varied due to absences from school. All of the students in the study, with the exception of one, were reading on a second-grade level according to reading inventories administered in January.

Teaching of Unit and Administering Tests:

After each 50 minute lesson was taught students left the regular class room for 40 minutes to attend resource classes. During this time six individual performance tests were set up at stations around the perimeter of the classroom. The test was administered to students after their resource period.

Six students were randomly selected to take the performance test on day one. Those selected for day three's test were not among those who took the performance test on day one. Any students who had not taken the performance-style test on day five took that format and the remainder were randomly selected from students who volunteered to take the performance test. On day seven students taking the performance test were arbitrarily selected from volunteers who had not completed that test format more than once. On all test days students who did not take the performance test

were administered the multiple-choice test.

Directions for all parts of the performance test were read and discussed with students before they began and periodically directions for particular sections were reviewed with individuals during the test. Directions for the multiple-choice test were also read and discussed with students before they began. Students taking the multiple-choice test were encouraged to raise their hand if they did not know what a picture or word was. They were given the word or name of any pictured item they did not know.

Students taking the multiple-choice test were not allowed to talk or get out of their seats while students completing performance tests were working. They were encouraged to work quietly on independent projects until everyone had finished testing. I circulated around the room completing the oral portions of the performance tests, answered any question about directions, words, or pictures, and collected completed tests.

Results

Both multiple-choice and performance tests were written to include questions that required higher order thinking. Students needed very little help with word or picture recognition on the multiple-choice tests and had no difficulty in following directions or understanding what was being asked in individual questions. Students needed frequent support in understanding directions on

performance tests even after reviewing test instructions and procedures before the test. They were able to read directions but often wanted clarification of instructions before completing the various parts of the test.

The range of scores for both test indicates that they adequately assessed instructional objectives for the test day. Scores reflected the ability of individual students to listen, comprehend, interpret, and apply science concepts presented. In both tests students had less difficulty with knowledge-based questions than with those requiring application, analysis, or evaluation.

The test score range for multiple-choice tests is slightly higher than for performance tests. Test score data is presented in Appendix C. Only once did a student receive a score on the performance test that was higher than those from multiple-choice tests. This occurred on day seven, a day in which all scores were lower than previous days. The mean score for composite of all multiple-choice tests was 80.31% and the mean score for a composite of all performance tests was 76.00%. Differences in mean scores for each day ranged from -0.37% to 6.86% The range of scores for both tests on every testing day are relatively parallel.

The time it took to write both multiple choice and performance tests was comparable. While there were more individual multiple-choice questions to write, it took about the same time to think out the

best way to assess content in a few performance items. Performance tests required additional time to gather materials required by the tests. For example, the test for day one required a photograph of a tree with some exposed roots next to a stream. It was necessary to go out and take Polaroid shots of a tree. Also, where the multiple-choice tests used drawings, I attempted to find photographs for performance tests. This was possible for day one but students taking the test did not have the same pictures. To be fair, I used photocopies of drawings on subsequent performance tests so that each student taking the performance test had the same materials.

Time required for set-up was significantly different. Both formats had a paper test package to pass out, but the performance tests also required other items. It took most of my 40 minute planning period to set up performance tests. Reading, writing, and project tables had to be cleared off; construction materials had to be gathered and then placed at each test station around the room; plants and other objects required as props for discussion and illustration also needed to be placed at each test center.

Another significant time factor was in administration and scoring. The multiple-choice test required an average of 20 minutes to administer and a few minutes to score each one. The performance tests generally took an hour to administer and an additional five to

eight minutes to score sections not scored during administration, and to tally points. When possible, students working on the performance test continued past parts of the test that required discussion with me or my checking their work. This helped reduce overall test time and made testing for individuals more efficient than if they had waited to complete sections in order. I rotated between the six stations to assess the oral portions of the tests and to check portions of the test that needed to be moved out of the way before work on another section could be begun. Some students had more room to spread out their materials than others. These students spent less time waiting on me during the test but often waited after they were done until I could get back to them to finish oral portions of the test. Students did not mind this inconvenience.

In an informal survey taken on the last test day 9 out of 14 (64%) students preferred the performance test to the multiple-choice test even though 11 out of the 14 (79%) felt they did better on the multiple-choice test. They said the performance test was more fun and since the lower grade would not directly affect them they did not care. (Second grade students do not receive letter grades on report cards at this school.)

Conclusion

Both multiple choice and performance tests are adequate evaluation tools for the assessment of instructional objectives in

science at the second grade level. Students were able to read both the test formats written for this study. While more assistance was required by students reading performance tests, this may have been because the format was unfamiliar to the students, whereas they had taken other multiple-choice tests. Both tests measured knowledge and achievement of instructional objectives. Performance tests did allow for a more true to life evaluation. Unfortunately, it required leaving some good application and synthesis activities out of lessons so that students could be asked to perform these activities as part of the test without having done so in class.

While performance tests will assess instructional objectives in science, multiple-choice tests are more advantageous because of the efficiency of time in preparation and administration, the impartiality, and the broader sampling of objectives. It took as long or longer to test the concepts taught on any given day with the performance format as it did to teach them. While it is true that in a normal classroom situation testing would be done at the end of the unit instead of every other day, the performance test still takes much longer to administer and score. The range of test results is not significantly different for either form, suggesting that nothing is gained from the additional time spent on the performance style test.

In fact, the multiple-choice test permits a broader sampling of

student behaviors because more questions can be asked. This would have greater impact when testing an extensive scope of objectives over a whole unit of study. Time constraints would limit content sampling with the performance test. By using a comprehensive sampling of students' behaviors the multiple-choice test results should better indicate ability and achievement including application of problem solving in "real world" situations. Also, the nature of the multiple-choice test, which allows students to chose from several responses rather than to offer information of their own, provides the examiner with specific understanding of the student's comparative thinking. On the performance test a student may give an appropriate answer but one that is not what the examiner sought from his or her point of view.

Scoring of multiple-choice tests not only requires less time, but also is more objective. The questions are scored equally for every student based on the answer key. It is more difficult to be equally fair to every student on the performance test. Preconceived notions of how an individual will perform may affect the scoring. Also, students who are more verbose may do better than more reserved students. In this study, some students drew pictures of habitats and labeled six things appropriately, but the items labeled did not necessarily show all their knowledge. For example, a student drew a bird's nest in a cactus and labeled the bird, the nest, and the eggs as three of his six items.

These items overlap one another and, while they are not incorrect, the student probably could have offered other items. The scorer must then decide to give credit for two similar items or to count them as one item. Performance tests that used items such as living plants or photographs should contain identical objects. Unfortunately, it is not always easy to find enough of the same item; and, when different specimens are used, it may affect the student's answers and skew scoring. Finally, objectivity in scoring performance tests is risked when administrators do not spend equal time with each student and, through questioning and discussion, prompt one student more than another. Students take cues from their teacher's body language and tone of voice and will respond accordingly.

A final determining factor in whether to use performance-based test in the future is the spatial requirements. In this study, I limited the number of my performance test subjects to six, as that is all the space I had to administer them in the classroom without significant changes to the layout of the room. If the whole class were to complete performance tests it would require drastic changes in the lay out of the classroom or administering the test in shifts.

Multiple-choice tests are superior to performance tests in terms of assessing a wide range of behaviors and justification of time spent in assessing, scoring, and administering. They are also more economical as they require no supplies beyond the paper on which

they are printed. Finally, the space requirements are more manageable for the multiple-choice test.

Discussion and Suggestion for Further Study

Multiple-choice tests certainly have significant advantages over the performance test in this study. Nonetheless, further evaluation of the two test forms is needed before any definitive conclusions should be made. The nature of the objectives tested may influence the adequacy of one format to assess ability and achievement. In this study both the specific state standards of learning and the classroom objectives required students to investigate and understand aspects of living systems. It is difficult to accurately reproduce a living system in the classroom. Perhaps performance tests would be superior for testing other objectives.

A second consideration is the age of the students in the study. Would performance tests be superior for testing older students who presumably would be looking at more involved issues? Also, students who are more familiar with the performance format may offer worthier information from which the test scorer could better delineate knowledge and ability.

Is it possible to increase the advantages of the performance test to justify the extra time and money they require? This can only be answered by continued research. In the interim, the multiple-choice test format does allow for reliable, cost-effective, comprehensive

testing of knowledge and achievement. This test format will definitely help teachers assess knowledge and achievement and help teachers prepare second grade students in Virginia for the State Standards of Learning Tests administered in third grade.

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Appendix A

Lesson Plans

for Unit on Livings Systems

Unit on Living Systems and Plants Life Cycle

Day 1

- based in part on Lessons 3 & 4 from *Teaching Guide/2 Discovery Works* by Silver Burdett Ginn Science

Classroom Objectives:

-classify objects into two groups: living or once-living and nonliving
-observe living plants
-identify main parts of plant
-explain function of roots, stems, leaves, flowers
-predict what will happen to a cut flower and a living plant when lifted from soil by the stem

Virginia Science SOLs:

2.4 Students will investigate and understand that plants and animals go through a series of orderly changes in their life cycles. Key concepts include

- flowering plants undergo many changes from the formation of the flower to the development of the fruit

2.5 Students will investigate and understand that living things are part of a system. Key concepts include

- living organisms are interdependent with their living and nonliving surroundings

Activities:

1. SW make a class chart of living or once-living and nonliving. Use activity card A -- collect materials ahead. See TE *A18 -19 (10 Min.)
2. SW use erasable maker to put L & O on living and non-living things in Woodland poster Book A1. See TE A20-21 (10 Min.)
3. SW sing 1st & 4th verse of The Life Cycle of plants song from "How Plants Grow" video (5 Mins.)
4. SW observe live plant and cut flower. See TE A34-35 Alternate Activity (10 Min.)
5. SW observe differences between the parts of a cactus and those of a dandelion, identify plant parts and explain their function using Poster Book page A3. SW use erasable marker to trace the way water moves through plant. See TE A36-37 (15 Min.)

Materials: chart paper, Activity Cards A1,potted plant, cut flower, potting soil, empty pot, bag of woodland objects, hand lens,Poster Book, erasable marker, song sheet, Picture Cards A1, A2, A3, A4

Homework: Read old Science Text** p 10-15 and answer review questions p 13 &15.

*TE=*Teaching Guide /2 Edition Discovery Works* by Silver Burdett Ginn Science

** Old Science Book = *Discover Science 2* by Scott Foresman

Writing assignment: Write a poem about a favorite plant . Use describing words so the reader can understand what the plant's parts are like.

day 2

Objectives:

-review concepts: plants are living and main parts of green plants
-explain what plants need to grow
-predict how plants will grow if they are missing either, air, light, or water
-predict, observe, and record how extreme temperature affects plant growth
-discuss how plants get food

Activities:

1. Sing 1st & 4th verse of The Life Cycle of plants song from How Plants grow video. Then discuss homework assignment and make 2 class webs on plant parts and what plants need to grow. Tell students they are going to set up experiments to show what happens if plants don't have what they need to grow. Remind students to keep all variables but the one we are testing the same.(10 Min.)
2. SW use **seedlings in 1/2 pint milk cartons prepared ahead** and subject them to different growing conditions. #1- control group, withhold nothing. #2- put plants in box in closest with no light. #3 -seal plants in clear plastic bag so they have no air #4 - do not water these plants Write predictions on lab sheet. (20 Min.)
3. SW use 3 similar healthy plants and place one by heater & window, one by freezer, and one in moderate environment in classroom. SW write prediction on lab sheet and observe each for five days. Use lab sheet to record results. (10 Min.)
5. SW watch and discuss "How Plants Get Food" video (skip experiment section) (15 Min.)

Materials:

experiment lab sheets, 3 similar healthy plants, seedlings in milk cartons, clear plastic bag, song sheets, "How Plants Get Food" Vol. 2 in the Biology of Plants video series by MBG Videos

Follow-up during daily Early Bird work time:

1. Give all plants needing water the same measured amount.
2. Record plant growth on lab sheet "What do Plants Need to Grow?" experiment for several weeks.
3. Observe & record results of "Temperature " experiment.

Homework: Read old Science book** p 18-21 and answer questions p 20.

** Old Science Book = *Discover Science 2* by Scott Foresman

Day 3

- based in part on Lesson 2 from *Teaching Guide/2 Discovery Works* by Silver Burdett Ginn Science

Classroom Objectives:

- explain how plants grow from seeds and parts of plants
- construct a terrarium model of a woodland habitat
- observe how plants and animals in the terrarium meet their needs
- identify plants and animals found in different habitats

Virginia Science SOLs:

2.4 Students will investigate and understand that plants and animals go through a series of orderly changes in their life cycles. Key concepts include

- flowering plants undergo many changes from the formation of the flower to the development of the fruit

2.5 Students will investigate and understand that living things are part of a system. Key concepts include

- living organisms are interdependent with their living and nonliving surroundings
- habitats change over time due to many influences

Activities:

1. Discuss homework assignment (Read old Science book** p 18-21 and answer questions p 20) and make class web on the different ways plants grow. (10 Min.)
2. Construct a terrarium model of a woodland habitat as a class and observe how plants and animals in the terrarium meet their needs using steps in Activity card 2 (15 Min.)
3. Ask children to identify plants, animals and physical features of the habits on Poster Book pages A2-A8. Show the pictures of cacti from the Windows on Science Primary Science Vol. 1 laser disc frames 10926-10939. Discuss how desert plants and animals are land dwellers that have adaptations that allow them to conserve water and live in extreme temperature and sea coast plants and animals have adaptations that allow them to live in water part or all of the time. (15 Min.)
4. Ask children to compare seashore, desert, and woodland habitats. What do plants and animals in those habitats need to live and how they get those things. Ask for volunteers to draw life cycle of a plant from one habitat on the black board. (10 Min.)

Materials: plants, soil, wood, sow bugs- and /or other living animals, gravel, watering can, container with lid and air holes, Poster Book pages A2-A8, Activity card 2, Science Notebook A18, laser disc player, Windows on Science Primary Science Vol. I,

*TE=*Teaching Guide /2 Edition Discovery Works* by Silver Burdett Ginn Science

** Old Science Book = *Discover Science 2* by Scott Foresman

Day 4

- based in part on Lesson 4 from *Teaching Guide/2 Discovery Works* by Silver Burdett Ginn Science

Classroom Objectives:

-recognize areas of the world are different

-describe plants & animals in: temperate forests (woodlands), North American & African Forests, grasslands, deserts, rain forests, andswamps

Virginia Science SOLs:

2.5 Students will investigate and understand that living things are part of a system. Key concepts include

- living organisms are interdependent with their living and nonliving surroundings
- habitats change over time due to many influences

Activities:

1. SW view & discuss pictures from Windows on Science Unit 5 section 1 Places on Earth (habitats). Refer to 7 lesson unit in Windows on Science manual for information and discussion questions. Discussion focus will be on how areas of the world are different, how plants and animals in each are adapted to their environment, how they use their living and nonliving surroundings, and how their environment may change over time. (40 Min.)
2. SW identify plants and animals in a swamp and tell how they are adapted to their environment, and how they use their living and nonliving surroundings using Poster Book A4 (see TE A44-A45*) (10 Mins.)

Materials: laser disc player, Windows on Science Primary Science Vol. 1, Poster Book, Picture Card A9 & A10

Homework: Old Science Book **pp22-23 and questions on p23

*TE=*Teaching Guide /2 Edition Discovery Work*s by Silver Burdett Ginn Science

** Old Science Book = *Discover Science 2* by Scott Foresman

Day 5

- based in part on Lesson 9 from *Teaching Guide/2 Discovery Works* by Silver Burdett Ginn Science

Classroom Objectives:

- describe different habitats in which plants grow
- identify plants and animals found in different habitats including the desert
- construct a desert garden
- observe desert plants
- develop plan to care for a desert garden

Virginia Science SOLs:

2.5 Students will investigate and understand that living things are part of a system. Key concepts include

- living organisms are interdependent with their living and nonliving surroundings
- habitats change over time due to many influences

Activities:

1. Discuss homework assignment and ask students how different plants parts have been adapted so they can live in their environment. (Old Science Book pp22-23) (5 Min.)
2. Sing The Desert and Rain Forest Habitat song from "How Plants live in Different Places" video (5 Min.)
3. Display Poster Book A2 and Ask students to recall how the Kealahari Grassland and Pacific Coast habitats differed. Then display Poster Book A9 and ask how desert plants are like other plants. Discuss how desert plant parts are adapted to help them live. Ask students how animals might also adapt. (See TE* A84-85) (15. Min.)
4. Construct a desert garden using steps in Activity card A6.(See TE A82 - 83)(15 min.)
5. Write a plan for taking care of the desert garden in your journal/learning log. Ask for volunteers to share plans and predict success for individual plans. (10 Mins.)

Materials: Activity card A9, potting soil & sand, small cacti and aloe, bowl, gravel spoon, song sheet, Poster Book, Picture Cards A16 & A17

Writing Assignment: Choice a plant and make a Sequence book on the life cycle of the selected plants. See A86 - include pictures of habitat

Homework: Old Science Book** pp36-40

*TE=*Teaching Guide /2 Edition Discovery Works* by Silver Burdett Ginn Science

** Old Science Book = *Discover Science 2* by Scott Foresman

day 6

- based in part on Lesson 10 from *Teaching Guide/2 Discovery Works* by Silver Burdett Ginn Science

Classroom Objectives:

- describe different plant adaptations to desert and rain forests
- identify plants and animals that live in the desert and rain forests
- predict and observe which leaf shape losses greatest amount of water
- compare woodland and desert plants

Virginia Science SOLs:

2.5 Students will investigate and understand that living things are part of a system. Key concepts include

- living organisms are interdependent with their living and nonliving surroundings
- habitats change over time due to many influences

Activities:

1. SW view and discuss "HowPlants Live in Different Places" video (25 Mins.)
2. SW sing The Desert and Rain Forest Habitat song from "How Plants live in Different Places" video (5 Min.)
3. SW observe how leaf shape affects water loss using Water Loss and Leaf Shape Activity D on page 11 of Teacher's Guide accompanying the video (10 Mins)
4. SW compare Activity Card A10 compare woodland and desert plants. Discuss how these might be changed over time. see TE A90-91*(10 Mins.)

Materials: How Plants Live in Different Place -- Vol. 5 in the Biology of Plants video series by MBG Videos, Activity Card A 10, woodland terrarium, desert garden, **pre cut** leaf in construction paper and waxed paper from patterns in from Teacher's Guide accompanying the video, water mister and hand lens, song sheets

*TE=*Teaching Guide /2 Edition Discovery Works* by Silver Burdett Ginn Science

day 7

- based in part on Lesson 6 from *Teaching Guide/2 Discovery Works* by Silver Burdett Ginn Science

Classroom Objectives:

- explore and hypothesize how bird's types of mouths are adapted to different environments
- infer how animals obtain food using their body parts
- predict and observe how insect color protects them from predators
- describe how people and animals change their environment

Virginia Science SOLs:

2.5 Students will investigate and understand that living things are part of a system. Key concepts include

- living organisms are interdependent with their living and nonliving surroundings
- habitats change over time due to many influences

Activities:

1. SW use models of two different types of bird's mouths to pick up food items as a class using Activity card A6 "Eating like a bird" (See TE* A58-59) (10 Mins.)
2. SW observe a variety of birds with different kinds of beaks and make hypotheses about how the get food. Then infer how other animals get food with their body parts using Poster Book A6 (See TE A60-61) (10 Mins.)
3. SW describe other body parts of birds that help them survive. Then suggest other body parts that help animals survive. (5 Mins.)
4. SW predict and observe how insect color protects them from predators using method in Math Science activity (See TE A61). Use 30 toothpicks of each color: red, yellow, green and hide in grass. Give students 10 seconds to find. Ask which was hardest to find? What color of insect would be most difficult for birds to find in the grass? (10 Mins.)
5. SW describe how animals and people in the Poster Book pictures A7 and A8, and picture cards A 13, A 14, A15 change their environments (see TE A 68-69 7 A76-77)

Note: If time allows sing all the unit songs.

Materials: Activity Card A6, tweezers, slotted spoon, uncooked rice on a log, foam peanuts in a container of water, **tooth picks colored in advance**, Poster Book, Picture Cards A11, A12, Science Notebook A22, song sheets

*TE=*Teaching Guide /2 Edition Discovery Works* by Silver Burdett Ginn Science

Appendix B

Tests

for Unit on Livings Systems

Name_____

Living Systems Unit Performance Assessment Day 1

Part 1(living/nonliving)

Look at the objects and pictures. Which ones are nonliving? Which are living or were once living? Place them on the chart board under the correct titles. **(Use a combination of eight objects and photographs. Students will receive 1 point for each.)**

Part 2 (plant parts)

Look at the plant. Be ready to tell me all you can about it. To get ready, you may want to draw a picture of a plant and label its parts. Think about what each part does. **(Use a real plant. Have students describe its parts and how they work. Students will receive 1 point for describing each 4 plant parts and for each giving the correct explanation of how it works)**

Part 3 (plants in our world **4 points each**)

Look at the picture of the tree growing on a river bank. Look at its roots. Draw how it might look in a few years on the paper labeled TREE. Then write a sentence or two explaining your drawing.

A scientist was trying to make a new kind of flower. He grew a big, heavy flower on a tall, thin stem. Use the materials provided to make a model of his flower. Draw a picture of what might happen to a big, heavy flower on a tall, thin stem on the paper labeled FLOWER. Then write a sentence or two explaining your drawing.

Name_____

Living Systems and Plant Life Cycle Unit Performance Assessment Day 3

Part 1

List 4 different animals or plants that would be destroyed by a forest fire. **(1 point each)**

1._____ 2._____

3._____ 4._____

List 4 different animals or plants that you might see if you went to the desert. **(1 point each)**

1._____ 2._____

3._____ 4._____

Part 2

Pedro's dad is planting a garden. He is using the things on the red mat to starts his plants.(**seeds, azalea stem in water, African violet leaf, pot of soil)** Be ready to explain which will grow and how.

oral questions **(1 point each)**:

1. Will they all grow?
2. How would you plant and care for the African violet leaf?
3. What is inside of a seed that helps a plant grow?

Part 3

Write a plan for taking care of our woodland habitat. **(3 points)**

_____

_____

_____

_____

Name_____

Living Systems Unit Performance Assessment Day 5

Part 1(Habitats)

Put the pictures in the correct place on the Forest/Woodlands/Desert Venn Diagram. **(Use a combination of 12 pictures. Students will receive .75 point for placing each picture correctly.)**

Part 2 (Desert Habitat)

Draw a picture of a desert habitat. Label 6 things in your picture. **(Students will receive 1 points for each correctly labeled item.)**

Part 3 (Desert and Rain Forest Plants)

Use the materials provided to make a desert plant and a rain forest plant. Be ready to tell how each is adapted to get what it needs. **(4 points)**

Name_____

Living Systems Unit Performance Assessment Day 7

Part 1(Birds' Beaks and Food)

Look at the pictures of the different kinds of birds' beaks and the kinds of foods. Which beaks would be best at getting each food? Place the food pictures under the picture of the beak that would be most able to get it. **(Use a combination of 4 beak pictures and 4 food pictures. Students will receive 1 point for placing each food picture correctly.)**

Part 2 (Animal body parts and food)

Draw three different kinds of animals **(do Not use birds)** and the kinds of food they might eat. Be ready to explain how each animal's body parts help them get their food. **(Students will receive 1 points for explanations)**

Part 3 (changes to environments)

A new family of beavers has moved to a stream. How might the family change the stream? Draw a picture of how it might look after some time. **(2 points)**

Look at the picture of the factory. It has a pipe pouring waste into a stream. How might the stream change? Add or cross out things in the picture to show the changes that might take place. **(1 point)**

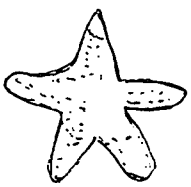
Name_____

Living Systems Unit Assessment Day 1

Look at the pictures. Circle the letter before the word that best describes each picture.

1. 
a. nonliving b. living or once living

2. 
a. nonliving b. living or once living

3. 
a. nonliving b. living or once living

4. 
a. nonliving b. living or once living

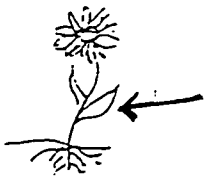
5. 
a. nonliving b. living or once living

6. 
a. nonliving b. living or once living

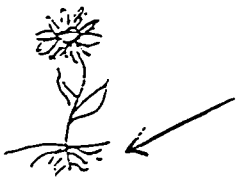
7. 
a. nonliving b. living or once living

8. 
a. nonliving b. living or once living

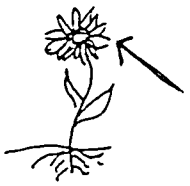
Look at the part of the plant the arrow points to. Circle the letter before its name.

9. 

a. root b. stem c. leaf d. flower

10. 

a. root b. stem c. leaf d. flower

11. 

a. root b. stem c. leaf d. flower

12. 

a. root b. stem c. leaf d. flower

Circle the best answer.

13. Which plant part carries water and nutrients to other parts of the plant?

a. root b. stem c. leaf d. flower

14. Which plant part makes food for the plant to use?

a. root b. stem c. leaf d. flower

15. Which plant part holds the plant in the soil and takes in water and nutrients from the soil?

a. root b. stem c. leaf d. flower

16. Which plant part gets water from the soil?

a. root b. stem c. leaf d. flower

17. Which plant part makes seeds?

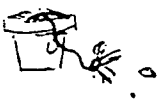
a. root b. stem c. leaf d. flower

18. If a big, heavy flower grew on a tall, thin stem. what might happen?

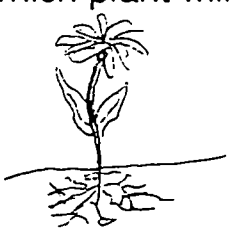
a. The stem would bend under the weight of the flower.

b. Leaves would grow to help hold up the flower.

c. The flower would die.



19. Which plant will get more water from the soil?

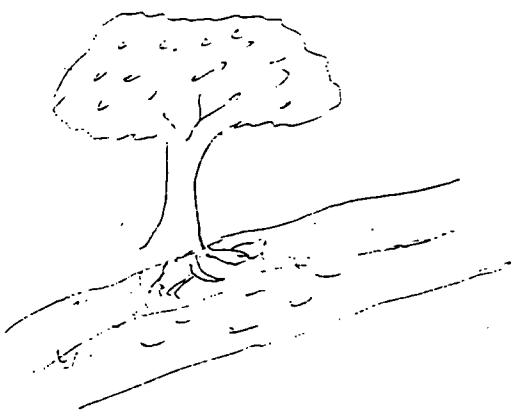


a. plant A

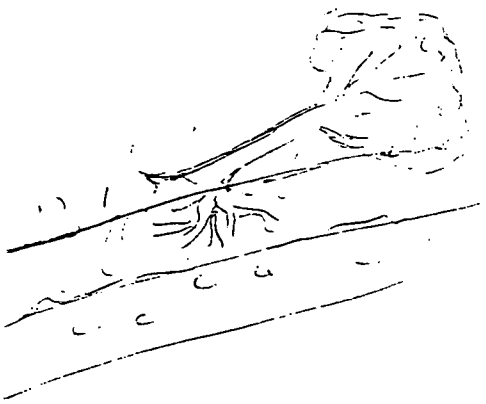
b. plant B

c. plant C

20. There is a big tree growing on a river bank. The soil around the roots slowly washes away. Which is true?



a. The tree will stand tall because because the trunk (stem) is strong.



b. The tree will slowly lean over because without a lot of soil the roots can not hold the tree in the ground very well.

Name_____

Living Systems and Plant Life Cycle Unit Day 3 Assessment

Look at the pictures. Circle the letter before the word that best describes where each plant or animal would be found.

1.  a. desert b. woodlands c. coast

2.  a. desert b. woodlands c. coast

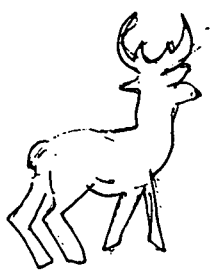
3.  a. desert b. woodlands c. coast

4. a. desert b. woodlands c. coast

5.  a. desert b. woodlands c. coast

6.  a. desert b. woodlands c. coast

7.  a. desert b. woodlands c. coast

8.  a. desert b. woodlands c. coast

Read each questions. Then Read **each answer before you** circle the best answer.

9. Which helps us know plants are living?

   a. people plant them

   b. they move from place to place

   c. they grow

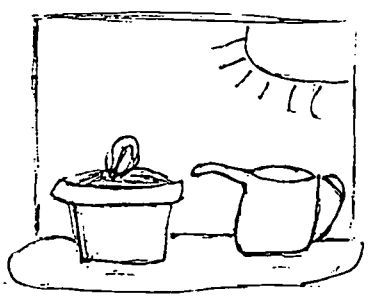
10. What can plants grow from?

   a. only seeds

   b. only leaves and roots

   c. seeds, leaves, roots, or stems

11. Betty's mom put a leaf from an African Violet plant in soil. If she keeps it watered and in a sunny place what will happen to it?



   a. It will die because it has no roots to get water.

   b. It will grow roots and leaves and flowers.

   c. It will grow without roots.

12. What is inside of a seed that helps a plant grow?

   a. soil and water for roots

   b. a tiny plant and food for it

   c. a flower and food for it

13. Why might whales be seen near the coast only during the summer?

   a. Whales migrate to warmer waters during cold seasons.

   b. Whales hide during the other seasons.

   c. People only look for whales during the summer.

14. How have desert plants have adapted living with little rain by?

a. growing very big roots.

b. storing up water.

c. growing in the shade.

Name_____

Living Systems and Plant Life Cycle Unit Day 5 Assessment

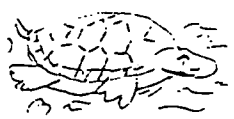
Look at the pictures. Circle the letter before the word that best describes where each plant or animal would be found.

1.  a. desert b. rain forest c. swamp

2.  a. desert b. rain forest c. swamp

3.  a. desert b. rain forest c. swamp

4.  a. desert b. rain forest c. swamp

5.  a. desert b. rain forest c. swamp

6.  a. desert b. rain forest c. swamp

7.  a. desert b. rain forest c. swamp

8.  a. desert b. rain forest c. swamp

Read each questions. Then Read **each answer before you** circle the best answer.

9. Which habitat is always very dry, hot, and sunny?

a. a desert
c. a polar region
b. a rain forest
d. a swamp

10. Which habitat is always very wet, warm, and shady ?

a. a desert
c. a polar region
b. a rain forest
d. a swamp

11. Which habitat has water almost everywhere?

a. a desert
c. a polar region
b. a rain forest
d. a swamp

12. What do Cacti spines help the plant do?

a. Store water for it to use.

b. Eat food from the ground.

c. Keep animals from eating it.

13. How do rain forest plants deal with water?

a. They grow very big roots to get water.

b. They have dip tip leaves to shed water.

c. They have fat stems to store up water.

14. Sonia's mom gave her a new plant. It has a fat stem, spines, and is planted in sandy soil. Where might it have come from?

a. a swamp

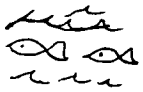
b. a woodland forest

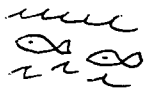
c. a desert

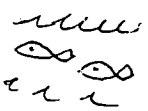
Name_____

Living Systems Unit Assessment Day 7

Look at the pictures of the bird beaks. Circle the letter before the food that would be easiest to pick up with each beak.

1.  a.  b.  c. 

2.  a.  b.  c. 

3.  a.  b.  c. 

Circle the letter for the best answer.

4. Why is the woodpecker's beak strong and pointed?

   a. to crack open seeds

   b. to scoop up fish from water

   c. to pick bugs out of trees

5. Which color insect is hardest to find in the grass?

   a. red

   b. yellow

   c. green

6. Why are insects often the color of the things around them?

   a. It makes it hard for animals to find and eat them.

   b. It keeps them the same temperature as the things near them.

   c. It is natures way of keeping the world pretty.

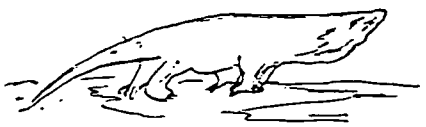
7. How do beavers' teeth help them build a dam?

   a. They push away water when they swim.

   b. They help them dig a hole.

   c. They help them cut down trees.

8. What is the anteater in this picture using to get food?

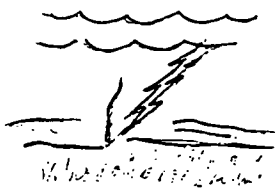


   a. Its ears help him hear termites and its paws help it catch them.

   b. Its claws tear open termite hills and its long snout and tongue help it catch termites to eat.

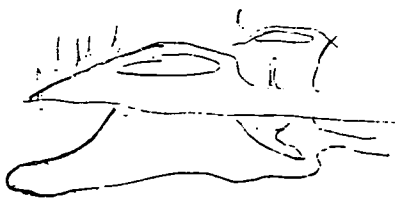
   c. Its tail helps it balance and its eyes help it find termites.

9. In which picture have people changed the land?

a. 

b. 

c. 

d. 

10. How can people help the land?

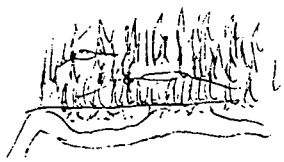
a. Let camp fires burn out alone.

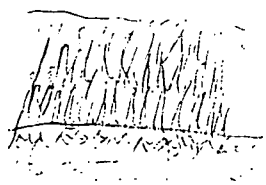
b. Pick up trash along streams.

c. Grow gardens every year.

11. A new family of moles has moved into Carl's yard. The moles will dig tunnels under the ground. How might the yard look after a few months?

a. 

b. 

c. 

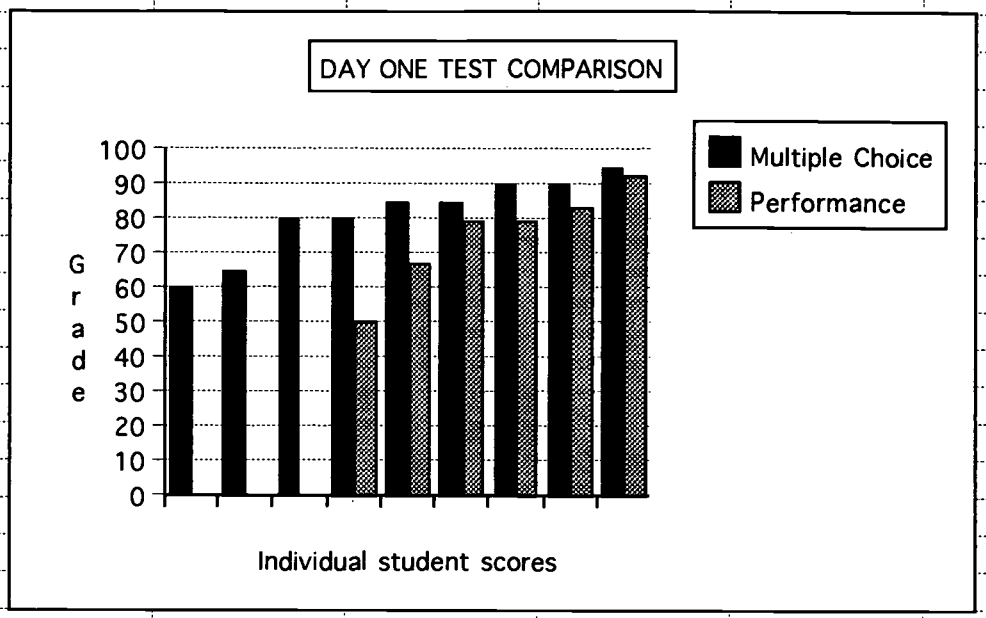
Appendix C

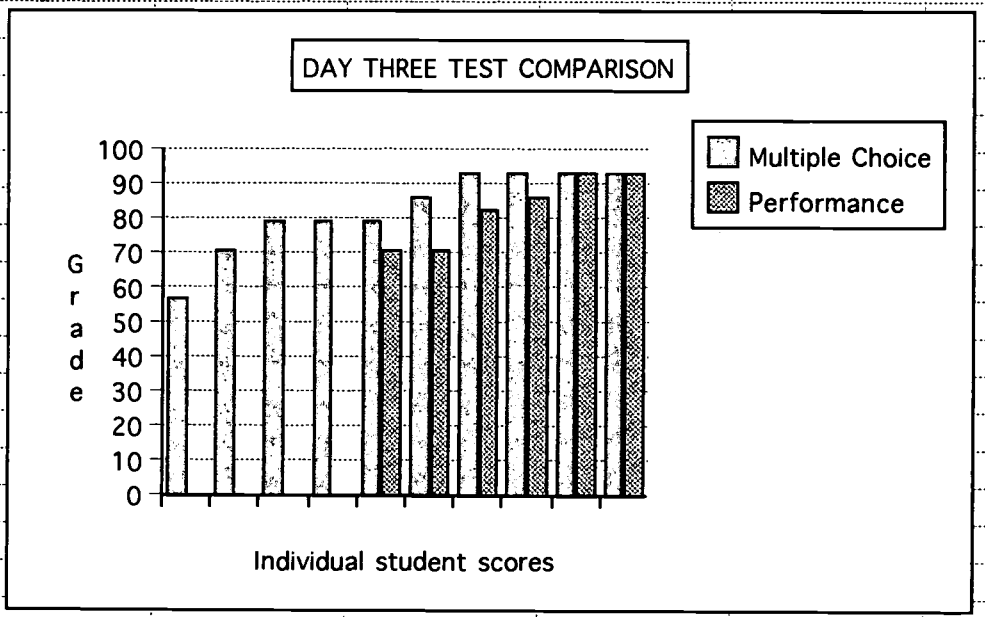
Research Data

Test Score Data

DAY ONE TEST COMPARISON											mean	difference
Multiple Choice	60	65	80	80	85	85	90	90	95		81.11	
Performance				50	67	79	79	83	92		75.00	6.11
DAY THREE TEST COMPARISON												
Multiple Choice	57	71	79	79	79	86	93	93	93	93	82.30	
Performance					71	71	82	86	93	93	82.67	-0.37
DAY FIVE TEST COMPARISON												
Multiple Choice		57	71	79	79	93	100				79.83	
Performance		67	68	71	76	80	96				76.33	3.50
DAY SEVEN TEST COMPARISON												
Multiple Choice	73	73	73	73	82	82	82				76.86	
Performance		35	60	70	80	80	95				70.00	6.86
							Composit multiple-choice score mean =					80.31
							Composit performance score mean =					76.00
Multiple Choice	60	65	80	80	85	85	90	90	95			
Multiple Choice	57	71	79	79	79	86	93	93	93			
Multiple Choice	93	57	71	79	79	93	100				mean multiple choice	
Multiple Choice	73	73	73	73	82	82	82				80.3125	

Test Score Data





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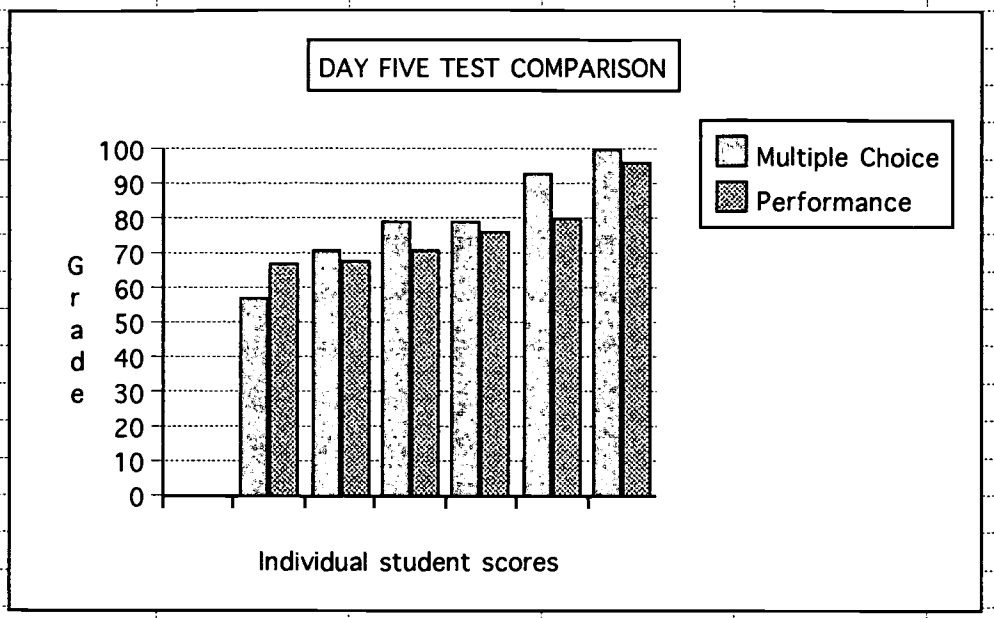

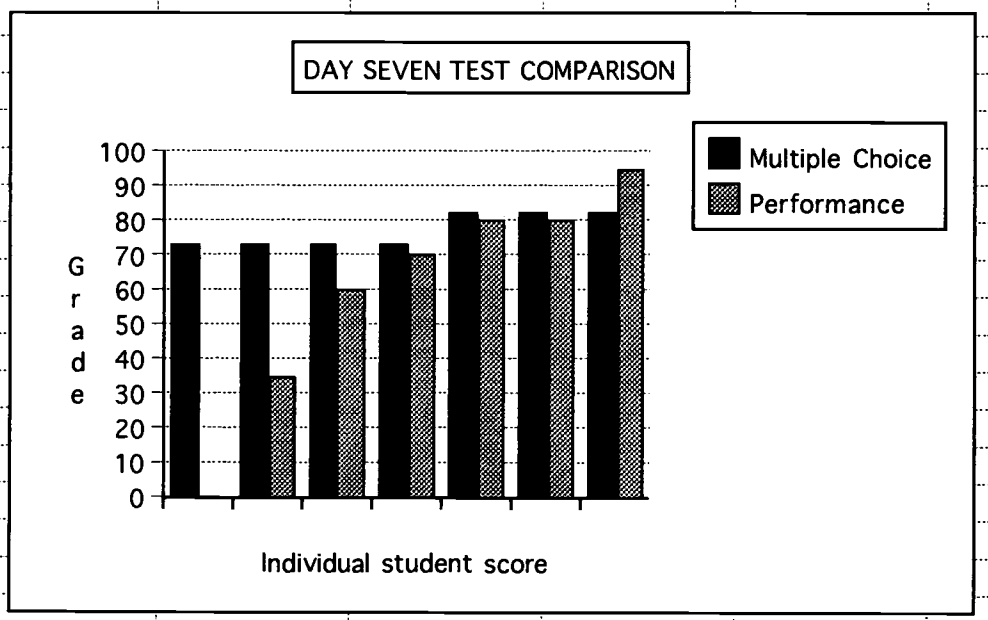

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